CLAIMS

What is claimed is:

1. A power transfer device for use in a motor vehicle having a powertrain and first and second drivelines, comprising:

an input driven by the powertrain;

a first output interconnecting said input to the first driveline;

a second output connected to the second driveline;

a bi-directional overrunning mode clutch operably disposed between said first and second outputs, said mode clutch is operable in a first mode to permit relative rotation between said first and second outputs in a first direction and prevent relative rotation therebetween in a second direction, said mode clutch is operable in a second mode to prevent relative rotation between said first and second outputs in both directions, and said mode clutch is operable in a third mode to permit relative rotation between said first and second output in both directions;

a mode shift mechanism operable in a first mode position to shift said mode clutch into its first mode, in a second mode position to shift said mode clutch into its second mode, and in a third mode position to shift said mode clutch into its third mode; and

a shift system for moving said mode shift mechanism to its first mode position to establish an on-demand four-wheel drive mode, to its second mode position to establish a locked four-wheel drive mode, and to its third mode position to establish a two-wheel drive mode.

2. The power transfer device of Claim 1 wherein said mode clutch includes a first ring driven by one of said first and second outputs, a second ring operably disposed between said first ring and the other of said first and second outputs, and rollers engaging a cam surface formed between said first and second rings, and wherein said second ring is adapted to index circumferentially relative to said first ring to cause said rollers to engage said cam surface for coupling said second ring to said first ring and said other of said first and second outputs, thereby coupling said second output for rotation with said first output.

3. The power transfer device of Claim 2 wherein said second ring is a split ring having an actuation slot defining first and second end surfaces, and wherein said mode clutch further includes an actuator ring having a lug retained in said actuation slot, and a drag band for exerting a frictional drag force on said actuator ring, said actuator ring is moveable between a first actuator position and a second actuator position, said actuator ring is operable in its first actuator position to permit bi-directional circumferential movement of said lug from a central position disengaged from both of said first and second end surfaces of said actuation slot into engagement with one of said first and second end surfaces, and said actuator ring is operable in its second actuator position to locate said lug in engagement with both of said first and second end surfaces of said actuator slot so as to maintain said lug in its central position, and wherein said actuator ring is normally maintained in its first actuator position by a biasing device.

4. The power transfer device of Claim 3 wherein said mode shift mechanism is operable in its first mode position to cause said drag band to exert said drag force on said actuator ring in its first actuator position, wherein said mode shift mechanism is operable in its second mode position to cause said drag band to release said drag force from said actuator ring in its first actuator position, and wherein said mode shift mechanism is operable in its third mode position to release said drag force while causing movement of said actuator ring from its first actuator position to its second actuator position.

5. The power transfer device of Claim 4 wherein said shift system includes an electric motor having a rotary output, and a drive mechanism for converting bi-directional rotary motion of said motor output into bi-directional translational motion of said mode shift mechanism between its three distinct mode positions.

6. The power transfer device of Claim 5 further comprising:

a control system having a mode selector capable of generating a mode signal indicative of the drive mode selected; and

a control unit receiving said mode signal and actuating said motor in response thereto for moving said mode shift mechanism to its mode position corresponding to the selected drive mode.

7. The power transfer device of Claim 1 further comprising:

a reduction unit having an input member driven by said input and an output member driven at a reduced speed relative to said input member;

a range clutch operable in a first mode to couple said first output to said input member of said reduction unit and establish a high-range drive connection therebetween, and said range clutch is operable in a second mode to couple said first output to said output member of said reduction unit and establish a low-range drive connection therebetween; and

a range shift mechanism operable in a first range position to shift said range clutch into its first mode and in a second range position to shift said range clutch into its second mode, and wherein said shift system is operable for coordinating movement of said range shift mechanism and said mode shift mechanism.

8. The power transfer device of Claim 7 wherein an on-demand high-range four-wheel drive mode is established when said mode shift mechanism is in its first mode position and said range shift mechanism is in its first range position, wherein a locked high-range four-wheel drive mode is established when said mode shift mechanism is in its second mode position and said range shift mechanism in its first range position, wherein a two-wheel high-range drive mode is established when said mode shift mechanism is in its third mode position and said range shift mechanism is in its first range position, and wherein a locked low-range four-wheel drive mode is established when said mode shift mechanism is in its second mode position and said range shift mechanism is in its second range position.

9. The power transfer device of Claim 1 defining a transfer case with an input shaft as its input, a first output shaft as its first output, and a second output shaft as its second output, and further including a transfer unit driven by said first output shaft with said mode clutch operably disposed between said transfer unit and said second output shaft.

10. The power transfer device of Claim 1 defining a power take-off unit having a transfer shaft as its input, a right-angled drive unit driven by said transfer shaft as its first output, and a second transfer shaft driving a differential associated with the second driveline as its second output, and wherein said mode clutch is operably disposed between said first and second transfer shafts.

11. The power transfer device of Claim 1 defining a power take-off unit having differential carrier of a differential unit associated with the first driveline as its first output and a right-angled drive unit as its second output, and wherein said mode clutch is operably disposed between said differential carrier and said drive unit.

12. The power transfer device of Claim 1 defining a power take-off unit having a first differential unit as its input, a drive unit as its first output, and a second differential unit as its second output, said first differential unit including an input member driven by the powertrain, a first output gear driving said drive unit, and a second output gear driving said second differential unit, and wherein said mode clutch is operably disposed between said first and second output gears of said first differential unit.

13. A transfer case for use in a four-wheel drive motor vehicle having a powertrain and first and second drivelines, comprising:

a first shaft for transmitting drive torque from the powertrain to the first driveline;

a second shaft for transmitting drive torque to the second driveline;

a transfer unit coupled for rotation with said second output shaft and having a hub surrounding said first shaft;

a bi-directional overrunning mode clutch operable for transmitting drive torque from said first shaft to said second shaft, said mode clutch including a first ring fixed for rotation with said first shaft and having first cam tracks, a second ring disposed between said first ring and said hub and having second cam tracks, rollers disposed within aligned pairs of said first and second cam tracks, an actuator ring supported for translational movement between a first actuator position and a second actuator position and having a lug disposed within an actuation slot formed in said second ring, a biasing unit for biasing said actuator ring toward its first actuator position, and a drag band for exerting a drag force on said actuator ring;

a mode shift mechanism moveable between first, second and third mode positions, said mode shift mechanism is operable in its first mode position to cause said drag band to exert said drag force on said actuator ring while located in its first actuator position for permitting movement of said lug from a central position into engagement with one of first and second end surfaces of said actuation slot so as to establish an on-demand four-wheel drive mode wherein relative rotation between said first and second rings is prevented in a first

direction and is permitted in a second direction, said mode shift mechanism is operable in its second mode position to cause said drag band to release said drag force from said actuator ring while located in its first actuator position for inhibiting movement of said lug into engagement with either of said first and second end surfaces of said actuation slot so as to establish a locked four-wheel drive mode wherein relative rotation between said first and second rings is permitted in both direction, and wherein said mode shift mechanism is operable in its third mode position to cause said drag band to release said drag force from said actuator ring and locate said actuator ring in its second actuator position for positioning said lug in engagement with both of said end surfaces of said slot so as to establish a two-wheel drive mode wherein relative rotation between said first and second rings is prevented in both directions; and

a shift system for moving said mode shift mechanism between its three distinct mode positions.

14. The transfer case of Claim 13 wherein said shift system comprises:

a drive mechanism coupled to said mode shift mechanism;

a power-operated actuator for causing said drive mechanism to move said mode shift mechanism;

a mode selector for permitting selection of at least said on-demand four-wheel drive mode and said locked four-wheel drive mode and generating a mode signal indicative of the drive mode selected; and

a control unit for receiving said mode signal and controlling actuation of said power-operated actuator for moving said mode shift mechanism to its first mode position when said on-demand four-wheel drive mode is selected and moving said mode shift mechanism to its second mode position when said locked four-wheel drive mode is selected.

15. The transfer case of Claim 14 wherein said mode selector further permits selection of said two-wheel drive mode which causes said control unit to command said power-operated actuator to move said mode shift mechanism to its third mode position.

16. The transfer case of Claim 14 wherein said control unit is further operable to cause said mode select mechanism to be moved from either of its first or second mode positions into its third mode position in response to detection of a braking condition.

17. The transfer case of Claim 14 wherein said drive mechanism is a rotary sector plate having a cam surface, wherein said mode shift mechanism includes a mode fork having a follower segment engaging said cam surface and a cam segment adapted to engage said drag band, and wherein said power-operated actuator is an electric motor operable for rotating said sector plate in response to control signals from said control unit.

18. The transfer case of Claim 17 wherein said cam surface is contoured to cause movement of said mode fork between its first, second and third mode positions in response to rotation of said sector plate, wherein movement of said mode fork to its first mode position causes a first portion of said cam segment to retract end portions of said drag band so as to permit said drag band to exert said drag force on said actuator ring, wherein movement of said mode fork from its first mode position into its second mode position causes a second portion of said cam segment to expand said end portions of said drag band so as to release said drag force from said actuator ring, and wherein movement of said mode fork from its second mode position into its third mode position causes said second portion of said cam segment to maintain expansion of said end portions of said drag band while said first portion of said cam segment forcibly urges said actuator ring to move from its first actuator position into its second actuator position.

19. The transfer case of Claim 13 further comprising:

a third shaft driven by the powertrain; and

a center differential having an input driven by said third shaft, a first output connected to said first shaft, and a second output connected to said hub of said transfer unit.

20. A transfer case for use in a four-wheel drive motor vehicle having a powertrain and first and second drivelines, comprising:

a first shaft for transmitting drive torque from the powertrain to the first driveline;

a second shaft for transmitting drive torque to the second driveline;

a transfer unit driven by said first shaft and having a hub surrounding said second shaft;

a bi-directional overrunning mode clutch operable for transmitting drive torque from said first shaft to said second shaft, said mode clutch including a first ring fixed for rotation with said second shaft and having first cam tracks, a second ring disposed between said first ring and said hub and having second cam tracks, rollers disposed within aligned pairs of said first and second cam tracks, an actuator ring supported for translational movement between a first actuator position and a second actuator position and having a lug disposed within an actuation slot formed in said second ring, a biasing unit for biasing said actuator ring toward its first actuator position, and a drag band for exerting a drag force on said actuator ring;

a mode shift mechanism moveable between first, second and third mode positions, said mode shift mechanism is operable in its first mode position to cause said drag band to exert said drag force on said actuator ring while located in its first actuator position for permitting movement of said lug from a central position into engagement with one of first and second end surfaces of said actuation slot so as to establish an on-demand four-wheel drive mode wherein relative rotation between said first and second rings is prevented in a first

direction and permitted in a second direction, said mode shift mechanism is operable in its second mode position to cause said drag band to release said drag force from said actuator ring while located in its first actuator position for inhibiting movement of said lug into engagement with either of said first and second end surfaces of said actuation slot so as to establish a locked four-wheel drive mode wherein relative rotation between said first and second rings is permitted in both direction, and wherein said mode shift mechanism is operable in its third mode position to cause said drag band to release said drag force from said actuator ring and locate said actuator ring in its second actuator position for positioning said lug in engagement with both of said end surfaces of said slot so as to establish a two-wheel drive mode wherein relative rotation between said first and second rings is prevented in both directions; and

a shift system for moving said mode shift mechanism between its three distinct mode positions.

21. The transfer case of Claim 20 wherein said shift system comprises:

a drive mechanism coupled to said mode shift mechanism;

a power-operated actuator for causing said drive mechanism to move said mode shift mechanism;

a mode selector for permitting selection of at least said on-demand four-wheel drive mode and said locked four-wheel drive mode and generating a mode signal indicative of the drive mode selected; and

a control unit for receiving said mode signal and controlling actuation of said power-operated actuator for moving said mode shift mechanism to its first mode position when said on-demand four-wheel drive mode is selected and moving said mode shift mechanism to its second mode position when said locked four-wheel drive mode is selected.

22. The transfer case of Claim 21 wherein said mode selector further permits selection of said two-wheel drive mode which causes said control unit to command said power-operated actuator to move said mode shift mechanism to its third mode position.

23. The transfer case of Claim 21 wherein said control unit is further operable to cause said mode select mechanism to be moved from either of its first or second mode positions into its third mode position in response to detection of a braking condition.

24. The transfer case of Claim 21 wherein said drive mechanism is a rotary sector plate having a cam surface, wherein said mode shift mechanism includes a mode fork having a follower segment engaging said cam surface and a cam segment adapted to engage said drag band, and wherein said power-operated actuator is an electric motor operable for rotating said sector plate in response to control signals from said control unit.

25. The transfer case of Claim 24 wherein said cam surface is contoured to cause movement of said mode fork between its first, second and third mode positions in response to rotation of said sector plate, wherein movement of said mode fork to its first mode position causes a first portion of said cam segment to retract end portions of said drag band so as to permit said drag band to exert said drag force on said actuator ring, wherein movement of said mode fork from its first mode position into its second mode position causes a second portion of said cam segment to expand said end portions of said drag band so as to release said drag force from said actuator ring, and wherein movement of said mode fork from its second mode position into its third mode position causes said second portion of said cam segment to maintain expansion of said end portions of said drag band while a third portion of said cam segment forcibly urges said actuator ring to move from its first actuator position into its second actuator position.

26. In a four-wheel drive vehicle having a powertrain and first and second sets of wheels, a power transfer unit comprising:

a first drive mechanism for transmitting drive torque from the powertrain to a first driveline for driving the first set of wheels;

a second drive mechanism for transmitting drive torque to the second pair of wheels;

a bi-directional overrunning mode clutch operable for transmitting drive torque from said first drive mechanism to said second drive mechanism, said mode clutch includes a first ring fixed for rotation with a driven component of said first drive mechanism and having first cam tracks, a second ring disposed between said first ring and a drive component of said second drive mechanism and having second cam tracks, rollers disposed within aligned pairs of said first and second cam tracks, an actuator ring supported for translational movement between a first actuator position and a second actuator position and having a lug disposed within an actuation slot formed in said second ring, a biasing unit for biasing said actuator ring toward its first actuator position, and a drag band for exerting a drag force on said actuator ring;

a mode shift mechanism moveable between first, second and third mode positions, said mode shift mechanism is operable in its first mode position to cause said drag band to exert said drag force on said actuator ring while located in its first actuator position for permitting movement of said lug from a central position into engagement with one of first and second end surfaces of said actuation slot so as to establish an on-demand four-wheel drive mode wherein relative rotation between said first and second rings is prevented in a first

direction and is permitted in a second direction, said mode shift mechanism is operable in its second mode position to cause said drag band to release said drag force from said actuator ring while located in its first actuator position for inhibiting movement of said lug into engagement with either of said first and second end surfaces of said actuation slot so as to establish a locked four-wheel drive mode wherein relative rotation between said first and second rings is permitted in both direction, and wherein said mode shift mechanism is operable in its third mode position to cause said drag band to release said drag force from said actuator ring and locate said actuator ring in its second actuator position for positioning said lug in engagement with both of said end surfaces of said slot so as to establish a two-wheel drive mode wherein relative rotation between said first and second rings is prevented in both directions; and

a shift system for moving said mode shift mechanism between its three distinct mode positions.

27. The power transfer unit of Claim 26 wherein said shift system comprises:

a power-operated actuator for moving said mode shift mechanism;

a mode selector for permitting selection of at least said on-demand four-wheel drive mode and said locked four-wheel drive mode and generating a mode signal indicative of the drive mode selected; and

a control unit for receiving said mode signal and controlling actuation of said power-operated actuator for moving said mode shift mechanism to its first mode position when said on-demand four-wheel drive mode is selected and moving said mode shift mechanism to its second mode position when said locked four-wheel drive mode is selected.

28. The power transfer unit of Claim 27 wherein said mode selector further permits selection of said two-wheel drive mode which causes said control unit to command said power-operated actuator to move said mode shift mechanism to its third mode position.

29. The power transfer unit of Claim 29 wherein said control unit is further operable to cause said mode select mechanism to be moved from either of its first or second mode positions into its third mode position in response to detection of a braking condition.

30. The power transfer unit of Claim 27 wherein said shift system includes a rotary sector plate having a cam surface, wherein said mode shift mechanism includes a mode fork having a follower segment engaging said cam surface and a cam segment adapted to engage said drag band, and wherein said power-operated actuator is an electric motor operable for rotating said sector plate in response to control signals from said control unit.

31. The power transfer unit of Claim 30 wherein said cam surface is contoured to cause movement of said mode fork between its first, second and third mode positions in response to rotation of said sector plate, wherein movement of said mode fork to its first mode position causes a first portion of said cam segment to retract said end portions of said drag band so as to permit said drag band to exert said drag force on said actuator ring, wherein movement of said mode fork from its first mode position into its second mode position causes a second portion of said cam segment to expand said end portions of said drag band so as to release said drag force from said actuator ring, and wherein movement of said mode fork from its second mode position into its third mode position causes said second portion of said cam segment to maintain expansion of said end portions of said drag band while said first portion of said cam segment forcibly urges said actuator ring to move from its first actuator position into its second actuator position.